CLAIMS

SWAT

1. Apparatus for treating an interval of a wellbore, said apparatus comprising:

a sand screen adapted to be connected to the lower end of a workstring; and

delivery means on the external surface of said sand screen for delivering a particulate-containing fluid suspension to different axial portions of said interval when said apparatus is in an operable position within said wellbore.

2. The apparatus of claim 1 wherein said delivery means comprises:

a plurality of blank conduits extending longitudinally along said external surface of said screen each of said conduits extending only a portion of the length of said interval and, at least one of said conduits having a lower end that terminates at a different level within said interval than the others.

3. The apparatus of claim 1 wherein said delivery means comprises:

a plurality of blank conduits extending longitudinally along said external surface of said screen each of said conduits extending only a portion of the length of said interval and, at least one of said conduits having an upper end positioned at a different level within said interval than the others.

4. The apparatus of claim 1 including:

a shroud surrounding said sand screen and said delivery means, said shroud having a plurality of openings in the wall thereof.

5. The apparatus of claim 1 including:

a cross-over connected to the upper end of said screen, said cross-over having outlet ports therein; and

a packer attached to said cross-over.

SUBMIT

6. Apparatus for gravel packing an interval of a wellbore by supplying a gravel bearing slurry, said apparatus comprising:

a sand screen adapted to be connected to the lower end of a workstring; and

a plurality of blank tubes with the tube ends axially spaced on the external surface of the sand screen for selectively delivering gravel slurry at a plurality of spaced axial locations of said interval when said apparatus is in an operable position within said wellbore.

7. The apparatus of claim 6 wherein said delivery means comprises:

a plurality of blank conduits extending longitudinally along said external surface of said screen, at least one of said conduits having a lower end that terminates at a different level within said interval than the others.

8. The apparatus of claim 6 wherein said delivery means comprises:

a plurality of blank conduits extending longitudinally along said external surface of said screen, at least one of said conduits having an upper end positioned at a different level within said interval than the others.

9. The apparatus of claim 6 including a shroud surrounding said sand screen and covering said blank tubes, said shroud having a plurality of openings in the wall thereof.

10. The apparatus of claim 6 wherein at least one pair of said blank tubes are substantially coaxially disposed in a spaced-apart, end-to-end orientation.

11. The apparatus of claim 6 wherein said blank tube ends have a beveled or arcuate shape.

12. The apparatus of claim 6 including:

a cross-over connected to the upper end of said screen, said cross-over having outlet ports therein; and

a packer attached to said cross-over.

13. An improved method of completing a subterranean zone subject to migration of particulates with the produced fluids penetrated by a wellbore comprising the steps of:

(a) placing in the wellbore in the zone a perforated liner having openings therein;

(b) placing a sand screen in said liner whereby a first annulus is formed between said sand screen and said perforated liner and a second annulus is formed between said perforated liner and said wellbore;

(c) positioning in said first annulus a plurality of blank conduits each having their ends open to fluids, at least one of said conduits having an end that terminates at a different level within the zone than the ends of one other conduit;

(d) isolating said second annulus; and

(e) injecting treatment particulate material into said first annulus, into said conduit and into said second annulus by way of the openings in said perforated liner, whereby the particulate material is uniformly packed in said first and second annuli and the migration of particulates with fluids produced into said wellbore from the zone is prevented upon subsequent production of fluids from the zone.

14. The method of claim 13 wherein said particulate treatment material is sand or manmade proppant..

15. The method of claim 13 wherein said wellbore in said subterranean zone is open-hole.

16. The method of claim 13 wherein said wellbore in said subterranean zone has the casing cemented therein with perforations formed through the casing and cement.

17. The method of claim 13 wherein said second annulus is isolated in accordance with the isolating step by setting a packer in said wellbore.

18. The method of claim 13 wherein said wellbore in said zone is horizontal.

19. The method of claim 13, which further comprises the step of creating at least one fracture in said subterranean zone prior to or while carrying out the injecting step.

20. The method of claim 13 wherein said perforated liner and said sand screen are placed in an eccentric position within said wellbore.

21. An improved method of completing a subterranean zone subject to migration of particulates with produced fluids penetrated by a wellbore, comprising the steps of:

(a) placing in a said wellbore in the zone a perforated liner having an internal screen disposed therein whereby a first annulus is formed between said screen and said perforated liner and a second annulus is formed between said perforated liner and said wellbore;

(b) positioning a plurality of blank conduits each having ends open to fluids, at least one of said conduits having an end that terminates at a different level within the zone than at least one of the other conduits;

(c) isolating said second annulus;

(d) pumping a slurry of particulate material into said first annulus into said conduits and into said second annulus by way of the openings in said perforated liner, whereby the particulate material is uniformly packed in said first and second annuli and the migration of formation particulates with fluids flowing into said wellbore from the zone is prevented upon flowing of fluids from said subterranean zone; and

(e) flowing fluids from the zone and into said wellbore.

22. The method of claim 21, which further comprises the step of creating at least one fracture in said subterranean zone.

23. The method of claim 21 wherein at least one pair of said conduits are substantially axially aligned in a spaced-apart, end-to-end orientation.

24. The apparatus of claim 21 wherein said conduit ends have a beveled or arcuate shape.

25. An assembly for completing a subterranean zone penetrated by a wellbore comprising:

a perforated liner;

a screen disposed within the liner whereby an annulus is formed between said screen and said liner;

at least one blank conduit in said annulus having upper and lower ends open to fluids;

a cross-over adapted to be attached to a production string attached to said perforated liner and sand screen; and

a production packer attached to said crossover.

26. A method for gravel packing a well that penetrates a subterranean oil or gas reservoir, comprising:

(a) providing a borehole casing in said reservoir;

(b) perforating said casing at preselected intervals in said reservoir to form at least one set of longitudinal, perforation tunnels adjacent a substantial portion of said reservoir;

(c) locating a screen inside the casing and in juxtaposition with said perforation tunnels, an annulus being formed between said screen and said casing;

(d) positioning in said annulus a plurality of conduits each extending only a portion of the length of said screen and having their upper and lower ends open to fluids to establish fluid communication between the conduits and said annulus, at least one of said conduits having an end that terminates at a different location within said reservoir than at least one other conduit;

(e) injecting a fluid slurry containing gravel down through said annulus and conduits whereby the fluid portion of the slurry is forced out of said annulus through said perforation tunnels into said reservoir and the gravel portion of the slurry is deposited in said annulus and forced into the perforation tunnels in the reservoir;

(f) sizing the cross-sectional area of said conduits and annulus so that if gravel forms a bridge in a portion of said annulus thereby blocking the flow of fluid slurry through the said annulus, fluid slurry containing gravel will continue to flow through the conduits and into the annulus around the gravel bridge; and

(g) terminating the injection of said fluid slurry containing gravel when the said annulus is completely packed with gravel.

27. A method for gravel packing a well that penetrates a subterranean oil or gas reservoir, comprising:

(a) providing a borehole casing through said reservoir;

(b) perforating said casing at preselected intervals there along to form at least one set of longitudinal, perforation tunnels adjacent a substantial portion of said reservoir;

(c) locating a sand screen inside the casing and in juxtaposition with said perforation tunnels, an annulus being formed between said sand screen and said casing;

(d) positioning in juxtaposition with said sand screen a plurality of conduits each extending only a portion of the length of said screen and having their upper and lower ends open to fluids to establish fluid communication between the conduits and said annulus, at least one of said conduits having a lower end that terminates at a different level within said reservoir than the others;

(e) injecting a fluid slurry containing gravel down the well and up through said annulus and conduits whereby the fluid portion of the slurry is forced out of said annulus through said perforation tunnels into said reservoir and the gravel portion of the slurry is deposited in said annulus and forced into the perforation tunnels into the formation;

(f) sizing the cross-sectional area of said conduits and annulus so that if gravel forms a bridge in a portion of said annulus thereby blocking the flow of fluid slurry through the said annulus, fluid slurry containing gravel will continue to flow through the conduits and into the annulus around the gravel bridge; and

(g) terminating the injection of said fluid slurry containing gravel when the said annulus is completely packed with gravel.

28. A method for gravel packing a well that penetrates a subterranean oil or gas reservoir, comprising:

(a) providing a wellbore in said reservoir;

(b) locating a screen inside the wellbore, an annulus being formed between said screen and said wellbore;

(c) positioning a plurality of blank conduits in said annulus, each conduit having its ends open to fluids to establish fluid communication between the conduit and said annulus, at least one of said conduits having an end that terminates at a different level within said reservoir than the end of at least one other of said conduits.

(d) injecting a fluid slurry containing gravel down through said annulus and conduits whereby the fluid portion of the slurry is forced out of said annulus into said reservoir and the gravel portion of the slurry is deposited in said annulus;

(e) sizing the cross-sectional area of said conduits and annulus so that if gravel forms a bridge in a portion of said annulus thereby blocking the flow of fluid slurry through the said annulus, fluid slurry containing gravel will continue to flow through the conduits and into the annulus around the gravel bridge; and

(f) terminating the injection of said fluid slurry containing gravel when the said annulus is completely packed with gravel. .

29. A method for gravel packing a well that penetrates a subterranean oil or gas reservoir, comprising:

(a) providing a wellbore in said reservoir;

(b) locating a screen inside the wellbore, an annulus being formed between said screen and said wellbore;

(c) positioning a plurality of blank conduits in said annulus, each conduit having its ends open to fluids to establish fluid communication between the conduit and said annulus, at least one of said conduits having an end that terminates at a different level within said reservoir than the end of at least one other of said conduits.

(d) injecting a fluid slurry containing gravel down the well and up through said annulus and conduits whereby the fluid portion of the slurry is forced out of said annulus into said reservoir and the gravel portion of the slurry is deposited in said annulus;

(e) sizing the cross-sectional area of said conduits and annulus so that if gravel forms a bridge in a portion of said annulus thereby blocking the flow of fluid slurry through the said annulus, fluid slurry containing gravel will continue to flow through the conduits and into the annulus around the gravel bridge; and

(f) terminating the injection of said fluid slurry containing gravel when the said annulus is completely packed with gravel.

30. A well screen comprising:

at least one upper and one lower screen joints, each of said joints having basically the same construction and each comprising:

a permeable section adapted to allow the flow of fluid therethrough while blocking the flow of particulates therethrough;

a plurality of blank conduits, each of said conduits extending along a portion of the length of said joint and being open at both its upper and lower ends; and

means for connecting the lower end of said upper screen joint to the upper end of said lower screen joint.

31. The well screen of claim 30 wherein each of said screen joints includes:

a shroud surrounding said permeable section and covering said conduits, said shroud having a plurality of openings in the wall thereof.

32. A well tool for delivering a fluid to a level within a wellbore, said well tool comprising:

a plurality of conduits each of said conduits adapted to be fluidly connected to the lower end of a workstring and having an inlet and an outlet spaced axially along said conduit whereby said outlet will lie adjacent said level when said well tool is in an operable position within said wellbore.

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